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Measurement of electrostatic stability of various TiO_2 dispersions in laboratory

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Introduction

Titanium dioxide can be utilized in various applications such as pigment base in paints, coatings, plastics and laminates. During both, the production process at the TiO_2 producer and the manufacturing process of paints, coatings and composite materials, avoiding the coagulation and agglomeration of the TiO_2 dispersion is important.

Surface chemistry of the TiO_2 dispersion can be controlled during the measurement of Electrokinetic Sonic Amplitude (ESA) by regulating the pH value e.g. for avoiding flocculation of dispersion. This means: the zeta potential of the dispersion should not be or close to zero.

Zeta potential is a dimension of the effective surface charge of particles and the interaction between the particles with ions in solution and particles among each other. Characterising the absolute surface charge (in an aqueous dispersion) of the TiO_2-pigment, negative or positive in the unit [mV], gives a decisive parameter for an ultimate application of the product.

The zeta potential depends on the kind of solvent, the nature and amount of the ions in solution (specific conductivity), and the pH value. It is also the main factor determining the stability of the whole dispersion.

Materials, measurement technique and devices

The applied materials and measurement techniques are listed as follows. The measurement of the TiO_2 dispersion was carried out at the Pulveranalyse GbR Labor Köln. Three TiO_2-pigments grades with different post-treatment in aqueous dispersion were tested.

Materials:

- Aqueous TiO_2 dispersion 30% wt
- 0.1 M HCl and 0.1 M NaOH (p. A.)

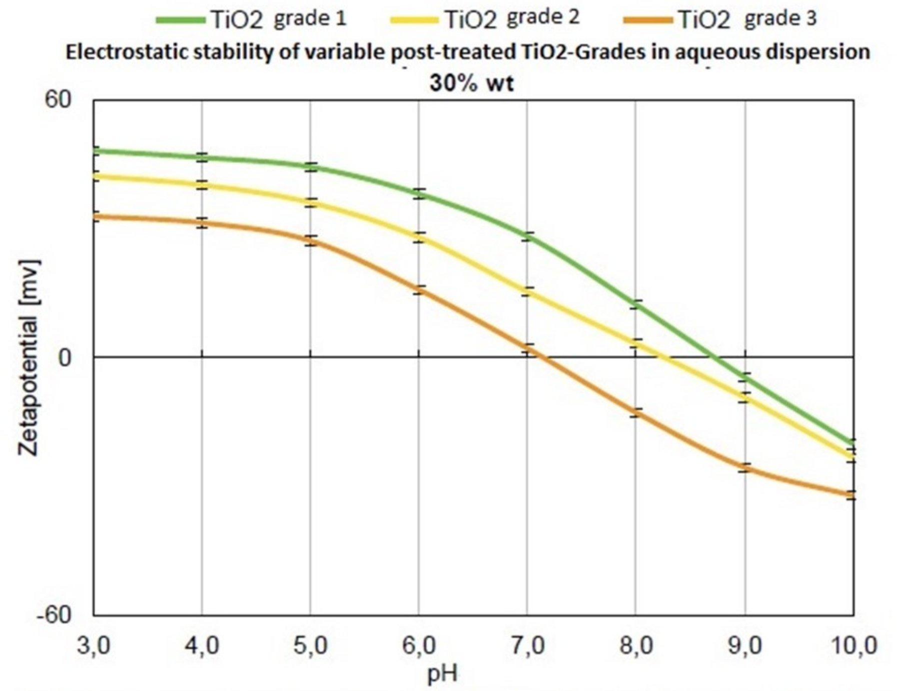

Fig.1: Zeta-potential of three variable post-treated TiO2-Grades in aqueous dispersion with a concentration of 30 wt%. Measured with method of Electrokinetic-Sonic-Amplitude ESA.

Technique

- ESA measuring system with programmable titrator. Hyper sensitive probe with 500kHz measuring frequency
- 50 mL ESA standard measuring cell, pH sensor, conductivity and temperature sensor, adjustable stirrer to prevent precipitation during measurement
- Software for data recording

Devices

- Ultraturrax T18 for dispersing with tool S18 N-19G

Results and discussion

Measuring the Electrokinetic Sonic Amplitude ESA delivers a clear distinction of the electrostatic properties of various grades of TiO_2 in aqueous dispersions.

The measurement results in Figure 1 show that the different TiO_2 grades differ in isoelectric point IEP and with regard to their zeta potential significantly from each other.

Handling TiO_2 dispersions in a range beyond the IEP avoids any kind of flocculation. Choosing pH values in an extreme area could be a disadvantage regarding both, the electrostatic property of the pigment surface and the ionic charge in the dispersion.

Conclusion

Electrokinetic Sonic Amplitude (ESA) measurements of highly concentrated dispersions are standard measurement methods. The ESA technique is state of the art for electro acoustic methods and has been developed for a whole range of different applications.

During the technical process dispersions are often found to be highly concentrated, muddy, coloured, tempered, or electro-statically affected by additive formulations. Sedimentation is often inhibited by powerful agitators in the large scale treatment containers. All these process conditions mentioned before can be involved in the stability analysis via ESA. The results of the analysed highly concentrated samples correlate directly with the electro kinetic properties of the dispersed particle in both, the raw material and the final product.

Info ESA measurement procedure

The ESA method is an electro acoustic measuring technique for characterising the charge stability of particles in dispersion.

An oscillating voltage, generated by an AC source, is applied to a suspension, dispersion, or emulsion.

Charged particles in dispersion vibrate with the frequency of an applied electric field. One or more frequencies can be applied. Sound waves are generated by the particle oscillation at these frequencies.

The amplitude of these sound waves gives the Electrokinetic Sonic Amplitude (ESA). The ESA signal is proportional to the dynamic mobility of the particle which in turn is proportional to the zeta potential of the particles in dispersion. For the use of this effect a certain density difference between the dispersion medium and the particle is required. For evaluable signals the density difference has to be at least 0.2 g/cm^3. The measurements can be carried out with dispersions in aqueous- and alcoholic solutions and paste-like formulations.